The Correlation between Dental Disorders and Hypertension, Coronary Heart Diseases, Parkinson's Disease, and COVID-19

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The literature review examines the growing prevalence of dental disorders and underutilization of dental clinics, which can lead to serious oral health issues. It explores associations between dental disorders such as oral cancers, dental cavity, and periodontal diseases, and other common diseases like hypertension, coronary heart disease, Parkinson's Disease, and COVID-19. Sources are principally from the PubMed Central database. The aforementioned diseases all have positive correlations with dental disorders. Oral cancer has positive association with hypertension, with a hazard ratio of 1.11, 95% CI [1.04-1.17]. Dental caries is connected to coronary heart disease and the frequency of visiting dental clinics, with 1.13 hazard ratio, 95% CI [1.04-1.22]. 16 out of 19 cities stated that their Parkinson's Disease (PD) patients have connections with periodontal diseases and dental cavity, and patients experience difficulties when visiting dental clinics. The relation between dysgeusia and COVID-19 has a hazard ratio of 8.61, 95% CI [5.26-14.11]. From the statistics, it assuredly concludes that certain dental disorders are in positive correlation with the diseases. This literary review obtains the results by reviewing the previous research papers published on PubMed. It forms a combination of the papers that explored the correlation between dental disorders and the systemic diseases.

Keywords: Dental disorders, Hypertension, Coronary heart disease, Parkinson's Disease, COVID-19.

Introduction

While our mouth and teeth play a critical role in fundamental daily activities like eating and speaking, their significance for health can be overlooked as people fail to prioritize proper dental care and hygiene. There is limited education about the importance of dental health. In 2020, only 62.7% of adults aged 18-64 in the United States visit dental clinics at least once a year[1]. As a result, serious oral disorders arise. Common oral diseases include dental caries, periodontal disease, and oral cancers, which often result from insufficient oral hygiene maintenance.

Dental disorders have linkages with other diseases, which underscore their seriousness. Cullin-3 is a gene that triggers hypertension if it is mutated[2]. The loss of this gene causes arterial stiffness and severe hypertension. Coronary heart disease (CHD) is inheritable. Kids who have a family history of cardiovascular diseases would more likely to be affected[3]. The most common gene that affects CHD is the chromosome 9p21 locus, which has 15-35% increased risk of developing[4]. Parkinson's Disease (PD) could potentially be a barrier for approaching proper dental healthcare[5]. The presence of external influences, such as air pollution, chemical exposures, and worsening climate could also result in respiratory problems which could lead to COVID-19 infection[6]. Dry climates results in dry mouth in individuals, in which one is more likely to develop cavities[7]. Although certain diseases are inevitable, a healthy lifestyle is necessary to maintain a healthy body to avoid the aforementioned diseases, as they could lead to dental disorders.

Previous literature reviews involve thorough investigations of systemic diseases, including their potential causes, ways to prevent, and methods to cure. Although several reviews relate the systemic diseases with dental health, they hardly make connections with the similarities in the causes of diseases. This literature review not only discusses the systemic diseases in detail, but also serves to make apparent linkages between them and different types of dental disorders, such as oral cancers, dental cavities, and taste disorders.

Methodology

This literature review obtains its evidence mainly from PubMed Central (PMC). It is a database which archives studies and reviews of biomedical and life sciences. Search results are collected from inception to March 2024.

In scientific research papers, hazard ratio and confidence interval (CI) are significant indicators to determine the relationship between diseases. Hazard ratio defined as a comparison of how one event happens in one group is linked to another group over time. If hazard ratio is one, this indicates that there is no linkage between the two comparing groups. If hazard ratio is greater than one, it means there is relationship between the two events.

Hazard ratio that is less than one shows the irrelevance of the two events. Confidence interval is another scientific indicator. It is a range of value showing the reliability of estimated results if redo the study. 95% confidence interval suggests that if the study is repeated, the true result will be within a calculated range. For example, the hazard ratio is 1.22, with a 95% confidence interval [1.19-1.27], then this result is reliable, and it also means that there is a connection between the two subjects tested since the hazard ratio is greater than one.

Population	People who have Dental Disorders.
Intervention	Dental care.
Comparator	People with no dental disorder.
Outcomes	Other systemic diseases (hypertension, CHD, PD, and COVID-19)
Timing	Any time horizon.
Setting	Mainly Asia.

Table 1 Eligibility inclusion criteria as described under PICOTS framework.

Results

Risk Factors of Dental Cancers and Hypertension and their Associations

Hypertension is the most prevalent disease in Africa and Asia[8]. It counts as hypertension when the pressure in blood vessels is higher than 140/90 mmHg. Genetic inheritance can cause hypertension. Mutation in the gene cullin-3 leads to hypertension[2]. Older age is also an inevitable risk factor. Having a diet with excess salt consumption would increase the probability of developing hypertension since high sodium concentration leads to water retention, which increases the blood volume and pressure[9]. Other common risk factors include obesity, tobacco consumption, drinking alcohol, and being physically inactive.

According to the statistics provided by the World Health Organization (WHO) in 2023, "hypertension is a major cause of premature death worldwide". Approximately 1.28 billion adults aged 30-79 have hypertension. Nearly half of them (46%) are not aware of the conditions they have and less than half (42%) are diagnosed[10].

Oral cancer has a 5-year survival rate of approximately 50% after treatment. Its risk of development significantly increases after a median age of 63 years. Tobacco consumption is one of the major risk factors for oral cancers. Tobacco causes nearly 6.4 million deaths each year. Specialists estimate tobacco consumption will cause over 8 million annual deaths by 2030. Alcohol consumption is another major cause of oral cancers, associated with nearly 10% of global deaths among those aged 15 to 49 years. Alcohol can lead to malignancies of the oral cavity, esophagus, larynx, pharynx, and liver. It can directly relate to 4.2% of cancer deaths, and 26.4% of oral cavity cancers worldwide[11].

A retrospective review conducted by South Korean researchers in 2020 investigated the relationship between hypertension with oral, laryngeal, and esophageal cancers among adults over the age of 40. Hypertension increased the risk of developing oral, laryngeal, and esophageal cancers with hazard ratios of 1.11, 95% CI [1.04-1.17]; 1.23, 95% CI [1.13-1.33]; 1.25, 95% CI [1.18-1.33], respectively[12]. For participants who do not have hypertension, the hazard ratios for each cancer are 1, which means they do not have the risk of developing the cancers.

Research indicates that oral cancers and hypertension have similar manifestations, and they have positive correlations with each other. To reduce the risk of getting infected by them, people should consider reducing their consumption of alcohol, and smokers should inhibit smoking as early as possible.

Connections between Dental Infections and Coronary Heart Diseases

Cardiovascular disease, resulting from disorders of the heart and blood vessels, is a leading global cause of mortality, responsible for nearly 20 million deaths annually. Its risk factors include tobacco use, alcohol consumption, unhealthy diet, obesity, and physical inactivity, which are quite similar to hypertension[13].

Coronary heart disease (CHD) is an example of cardiovascular diseases, arising from blockages of the blood supply by fatty deposits in coronary arteries in the heart. It is considered as a hereditary disease as the mutated gene in the chromosome 9p21 locus can lead to CHD[4]. Environmental factors that cause CHD including high cholesterol, hypertension, smoking, and diabetes can cause CHD, since they lead to atherosclerosis where the arteries are filled with fatty substances[14].

Dental caries represents the most widespread noninfectious disease globally, affecting around half of the population. Children and adolescents have the highest risk of developing cavities, while the symptoms are more significant in adults, since dental cavities are cumulative. Dental caries is also known as tooth decay, where the enamel and dentine are lost by sugar consumption. The bacterial metabolism of sugars results in the acid production of the tooth substances, which leads to the development of dental caries. Early stages are usually without symptoms; however, advanced stages could have pain, chronic systemic infections, adverse growth patterns, and abscesses. Thus, a dental cavity is caused by dietary free sugars, and limiting sugar consumption is key to reducing the likelihood of developing cavities[15].

This retrospective review collected data among middle-aged Korean adults from 2002-2013, which examined the association between dental caries and coronary heart disease. Result indicates that about 68% of patients with dental caries are in advanced stage, and the mean age of them (55.0) is higher than those who are in moderate stage (52.9). It revealed a significant

association between dental caries and coronary heart disease. An investigation was done on the relationship between CHD and advanced stage dental caries of the outpatient visits of CHD patients frequency within seven years. It suggested that the CHD patients who visit dental clinics 32-55 times during the investigation have higher possibility of developing dental cavity, with a hazard ratio of 1.13, 95% CI [1.04-1.22] considering all the factors such as sex, residential area, alcohol consumption, smoking, and genetic inheritance of heart diseases; while those who visit clinics 5-9 times in the seven years do not have the association with dental caries, with a hazard ratio of 0.87, 95% CI [0.80-0.95] [16].

As shown in the studies, CHD has a positive correlation with dental caries. Risk factors that have CHD include high cholesterol level which results in atherosclerosis, while in dental caries can be caused by the bacteria in sugars. A healthy diet which contains less fat components, and reduced sugar consumption must be achieved in order to decrease the chances of developing CHD or dental cavities.

Linking Parkinson's Disease with Oral Health Disorders

Parkinson's disease (PD) is a neurological disease and a motor system disorder in which parts of the brain are damaged over years. Patients with PD have physical symptoms, such as tremors (shaking of certain parts of the body), rigidity (stiff muscles), dementia, and insomnia (sleeping problems). The presence of these symptoms could lead to psychological issues, such as depression and anxiety17; they also lower the quality of life for the patients.

PD occurs when nerve cells are lost in the substantia nigra and the level of dopamine decreases in the brain. It can be caused by genetic factors, where mutations occur in the PARK2 gene, which is also called PRKN [17]. It is a gene that codes for a protein called parkin. Its mutation causes the autosomal recessive PD, and has a possibility of 10-20% for the onset of PD [18]. Age is the primary risk factor of PD; it affects 3% of people over the age of 65, and 5% of the population over the age of 85 [19]. Men are twice more likely to get PD than women [20].

Periodontal disease is also known as gum disease, gingivitis and periodontitis, which is another frequent oral disorder. It is caused by a pathogenic microbiota that trigger inflammatory immune responses, which leads to the destruction of tissues around the teeth, gradually spread to bones, and will eventually cause tooth loss. It is a significant cause of tooth loss in adults [21]. The major manifestations of PD create a burden for maintaining dental health in various ways. PD patients experience oral halitosis, orofacial pain, and serious periodontitis along with tooth decay.

Nevertheless, PD patients have lower standards of living due to the poor maintenance of dental health. First of all, the quality of toothbrushing would decline, since PD patients have tremors of hands and tongue. As PD progresses, the symptoms become more severe, resulting in worsening oral health over time for patients. PD patients also become more uncomfortable with mouthwashes, due to the fear of choking. Secondly, PD patients are a challenge for dental clinicians. They have issues with muscle movements, and that makes it difficult for them to move in and out of the dental chair. PD patients also have difficulties changing postures during dental checks, which is inconvenient for both patients and dentists during dental procedures. Supine positions could lead to dangerous accidents such as the ingestion of dental instruments. Last but not least, the patient-dentist relationship is hard to maintain. PD patients sometimes have unclear pronunciations, so patients and dentists need to use non-verbal communication, which would cause misunderstanding between them. This result can be frustrating and the care is not able to continue, and fewer PD patients would visit dental clinics, which reduces their chances of maintaining their oral health [22].

Although deep brain stimulation can be used to treat PD [17], it is one of the most common diseases, and patients with PD are increasingly difficult to treat in dental health. Their symptoms such as trembling make it hard for them to stay still in position, which is challenging for dentists to check.

Connections between Taste Disorder and COVID-19

COVID-19 is a disease caused by the SARS-CoV-2 coronavirus. It transmits between people in close contact such as talking and shaking hands. According to WHO, until August 2023, over 760 million cases and 6.9 million deaths were recorded globally since December 2019 [23]. The symptoms of COVID-19 vary in people. The most common ones are fever and sore throat, since the virus attacks the air passage. Others include fatigue, headache, dizziness and loss of sense of taste or smell. Pre-existing health issues such as lung cancer have higher risks when they get COVID-19 [24]. In an investigation among U.S. patients who had a lung cancer diagnosis in 2020, it shows a hazard ratio of 7.14, 95% CI [6.91-7.39] in relation to COVID-19 [25].

Taste disorder is the loss of sense of taste, where flavors like sweet, sour, bitter, salty, and savory cannot be detected by taste buds. The sense of smell is closely related to taste. When people lose their sense of taste, they have dysfunctional anosmia. Losing the sense of taste can significantly impact health, as it can lead people to add more sugar or salt to foods in an attempt to enhance flavor perception [25]. Excess sugar results in obesity, and consuming too much salt could lead to hypertension, which affects patients' health.

The sensitivity of taste is lost by the increase in age. There are approximately 2,000 to 4,000 taste buds in adults, and each of them has 50 to 100 sensory cells. People start to lose them after the age of 50, since the damaged receptors and sensory neurons

can no longer be replaced by the new ones[26]. Taste disorders can also arise from upper respiratory, middle ear infections, and ear surgeries. There are three main types of taste disorders: dysgeusia, hypogeusia, and ageusia. Dysgeusia is characterized by a metallic taste perception instead of normal taste, often occurring alongside Burning mouth syndrome (BMS). BMS is an idiopathic orofacial pain that recurs for more than 2 hours per day and more than 3 months. It has symptoms such as burning, itching or numbness of the tongue, lip, palate and gums. BMS patients feel the most pain in the late evenings[27]. Hypogeusia is simply the decline of the ability to taste things. Ageusia is the inability to taste anything, which is the severest scenario in taste disorders.

Taste disorder is closely related to COVID-19. The British Association of Otorhinolaryngology (ENT-UK) stated that anosmia and dysgeusia varied from 3-20% in COVID-19 patients[28]. A meta-analysis comprised 107 studies of anosmia and 101 studies of dysgeusia to reveal their prevalence in COVID-19[29]. In 32,142 COVID-19 patients, there were 12,038 anosmia cases reported, with a prevalence of 38.2%, 95% CI: 36.5%, 47.2%; among the 101 studies of the dysgeusia in 30,901 COVID-19 patients, there were 11,337 dysgeusia patients, which resulted in a prevalence of 36.6%, 95% CI [35.2-45.2]. 20 studies which include 1,213 COVID-19 patients with anosmia showed an odds ratio of 10.21, 95% CI [6.53-15.96]. 16 studies composed of 1,342 COVID-19 patients with dysgeusia suggested an odds ratio of 8.61, 95% CI [5.26-14.11].

COVID-19 is a common topic that people often talk about during the past four years. Hygiene and vaccinations are important to make sure that more people stay away from it as much as possible, so the risk of developing taste disorders can also be prevented.

Discussion

Systemic diseases have great impact on dental disorders. Hypertension has correlations with oral, laryngeal, and esophageal cancers as investigated by Korean researchers. The hazard ratio for patients of hypertension to develop oral cancer is 1.11, 95% CI [1.04-1.17]; 1.23, 95% CI [1.13-1.33] for hypertension with laryngeal cancer; 1.25, 95% CI [1.18-1.33] for hypertension with esophageal cancer. Coronary heart disease is in relation to dental caries in Korean adults. Aged people are more likely to develop both CHD and dental cavity. Research also shows that CHD patients are more likely to develop dental cavities, so they have more frequent outpatient visits to dental clinics, with a hazard ratio of 1.13, 95% CI [1.04-1.22]. Oral health can be significantly influenced by Parkinson's Disease, in which PD patients are relatively difficult to diagnose in dental checking procedures, which results in the inability to do checks and treatments. Taste disorders such as dysgeusia have strong connections with COVID-19.

There are challenges and barriers that deter people from approaching dental care. First of all, people have a great amount of workload, so they have less time to do other things, such as having regular dental checks. Also, oral examinations are expensive. Most households are prudent when it comes to a large amount of expense, which decreases their chances of receiving dental diagnosis[30].

However, there are still some limitations of this particular review paper. It lacks the exploration of practical experiments, which decreases the reliability of true causation of the disorders. Also, the research could be on a wider scope. It would be better if it is focused more globally.

There are confounding variables that need to be addressed. As hypertension and CHD can be caused potentially by smoking, it is a confounding factor. The increased risk in dental disorders may be caused by smoking but not hypertension or CHD. Smoking itself is found to have strong association with dental diseases, as smokers are 4.65 (95% CI [3.19-6.77]) more likely to develop oral cancer[31]. Furthermore, in an investigation of another review paper, it states that 80% of smokers do not take care of their teeth[32]. Therefore, it clearly shows that smoking is a confounding factor in the association between hypertension and CHD with dental disorders.

This literature review aims to increase awareness and knowledge of dentistry and oral health, the associations between dental disorders and disease, and preventive strategies. Accumulated dental issues can become more severe later in life, and can lead to the aforementioned diseases. Taking a decent care of one's dental health is important, in order to reduce the possibility of getting other diseases or deteriorating dental diseases. There are various ways to maintain dental hygiene that people should pay attention to, including brushing teeth regularly, consuming less sugar substances, and making regular visit to dental clinics to prevent major dental issues as much as possible.

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